

ences an overwhelming—for example, incapacitating—physiologic response to physical or emotional stimuli associated with a disorientation event.” The bottom line is the pilot may be aware of the disorientation but is unable to respond to correct the situation.

For more information on spatial disorien-

tation, contact your local wing aeromedical safety officer or the Aviation Survival Training Center. Remember, to the other guy, you are the other guy. 🦅

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# Can We Prevent SD?

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## Spatial DISORIENTATION

### The Tactile-Situation-Awareness System

Spatial disorientation (SD) and its effects and remedies have been discussed repeatedly over the years in every ready room; yet, we continue to lose aircraft and lives. Based on accident rates for the Air Force, Navy, and Army, SD mishaps result in the tragic loss of 40 lives per year on average. The cost of SD mishaps also includes mission failure, the impairment of mission effectiveness, and the cost (in billions of dollars) of aircraft and equipment loss.

The losses are staggering when compared to how many could have



been saved if they had had something in the cockpit to help the aircrew cue into their situation. In today's military aviation, there is an added emphasis on night flying, all-weather capability, and low-altitude missions, which are all scenarios that increase spatial disorientation.

Researchers at Naval Aerospace Medical Research Laboratory (NAMRL) have developed a product to cue in the aircrew; it's called the tactile situation-awareness system (TSAS). TSAS uses the sense of touch to provide spatial-orientation and situational-awareness information to aviators. The system reads data from current aircraft systems, processes it, and relays designated information, using miniature tactile stimulators

engaged in a conversation and someone comes up behind you and taps you on the shoulder, the urge to stop talking or listening and turn around to see who tapped you is irresistible. You always turn quickly toward the tapping. It's this overwhelming sense to react that TSAS bases itself: tactile stimulation. TSAS is designed to support the pilot by providing another avenue of cueing, besides the visual and aural cues already integrated in today's aircraft.

The TSAS system accepts data from the aircraft via 1553 interface as a bus monitor to obtain the aircraft position, velocity, attitude, altitude, and threat information. This information is then displayed via the pneumatic tactors arrayed



The system reads data from current aircraft systems, processes it, and relays designated information, using miniature tactile stimulators called tactors.

called tactors. Two types of tactors are currently available: pneumatic and electromagnetic. The pneumatic tactors are made of plastic bodies with latex bladders. Air is pulsed through the tactor and felt as a distinct tapping when placed against the body. The electromagnetic tactors have a magnet and electrical coil, which, when energized, produce a unique tapping sensation that "feels" different than the pneumatic tactors.

This research taps into our underutilized sense of touch. For example, when you're





Photos provided by NAMRL

around the torso in columns, and electromagnetic tactors located on the shoulders and lower thighs. The tactors are mounted in a cooling vest, weighing less than one pound, and in the aircraft seat. A quick-connect-disconnect fitting does not impede egress in an emergency.

Similar to “pages” on a multi-function display, TSAS has different modes for displaying critical information. In the forward-flight mode, TSAS provides attitude and altitude cueing. It also can provide backup navigational cueing in conjunction with existing navigation displays.

In a hover mode for helicopters, TSAS provides horizontal drift and vertical-altitude information. TSAS has proven to be especially valuable when visual cues are degraded, as in high hovers during fast-rope situations over a target, when the pilots are on NVDs. TSAS also is valuable in high-low hovers over open ocean, as in SAR, mine sweeping, dipping, or even Doppler approaches and hovers.

The Army specifically has requested that TSAS provide approach glide-slope cueing for a pilot-adjustable-hover altitude, as well as a zero-zero, no-hover landing. This cueing provides deceleration and lateral-drift information during the approach. This information will aid in alleviating brown-out and white-out landing mishaps, where lateral drift during landings has led to rollovers.


In the threat mode, TSAS provides cueing

The Naval Aerospace Medical Research Laboratory in Pensacola, Fla. is dedicated to solving medical issues that effect naval aviation. The laboratory reports to Naval Health Research Center (NHRC), San Diego, Calif.

Through its research, NAMRL directly supports the Fleet and Sea Power 21 by enhancing human performance, optimizing equipment, preventing mishaps and improving personnel selection. The laboratory’s areas of research includes spatial orientation, situational awareness, effects of hypoxia, motion sickness, aircraft mishap modeling, vision, pharmaceuticals and human performance, and adaptation to unusual acceleration environments. The laboratory has experts in aircraft mishap investigations and is the Department of Defense’s only laboratory for aviation selection research. NAMRL also has the world’s finest collection of man-rated, acceleration-research devices.

toward the enemy, whether it’s another aircraft or incoming missile. It tells the pilot where the threat is, enhancing his situational awareness (SA), while cueing him to look or react to the threat without having to first look in the cockpit, identify the threat, go back outside the cockpit (visually) to reacquire the threat, then react to it. These few seconds are critical in a wartime environment.

An added benefit of the system is the cooling effect provided by the vest. TSAS currently provides ambient air through the vest to provide some cooling, and it can be modified to allow heated and chilled air through the system.

Currently, simulator and aircraft testing have begun with the Special Operations Command MH helicopters and CV-22 aircraft programs. 

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